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# Bio-diesel as Sustainable Energy Source

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## Abstract

Conventional fuels have been continuous in use from a long time. These are petroleum based fuels and are obtained by the refining process of the crude oil obtained from the deep under sea and under the surface of the earth mining of the fossil fuels which takes about millions of years for their generation. As these resources are used by the man in very high amount from a long time, so they are now at the verge of exploitation and also these are the major source of the pollution. So there is need to find a substitute of these fossil fuels which can just replace these fossil having similar properties. So in this research paper the study has been focused on the biodiesel to study it for the purpose of using it as the alternative fuel for the fossil fuels. This study will be helpful for the researchers doing their study in the biodiesel, students who want to gain knowledge in this alternative fuel and also to industrialists to discuss the merits and demerits of the biodiesel or the biofuels.

**Keywords:** Alternative fuel; Biodiesel; Conventional fuels; Fossil fuels mining; Petroleum fuels; Pollution; Refining

## Introduction

Biodiesel is a form of diesel fuel which is naturally extracted from the plants & the animals. Biodiesel is a long chain of fatty acid esters. It is typically obtained by the chemical reaction between the lipids and the animal fat or the soybean oil. It can also be obtained from the chemical reaction of the vegetable oils with the alcohol producing methyl, ethyl or propyl ester. These are defined as the mono-alkyl esters of vegetable oils or animal fats. It is the best candidate for diesel fuels in diesel engines. It also burns like petroleum diesel as it contains regulated pollutants. It has better efficiency than the gasoline. The process used for the conversion of the oils into the biodiesel is known as the transesterification [1].

## Biodiesel better than conventional fuels

**Emissions:** One of the major problems with the fossil or conventional fuels like petrol, diesel is that these fuels emit toxic pollutants. These pollutants act as the greenhouse gases which forms a layer like cover around the atmosphere of the earth surface which causes the trap of the sun's ultraviolet rays [2]. This trapping of the sun rays becomes the cause for the global warming. In contrast to that biodiesel does not emit out as much carbon or the toxic pollutants as the conventional fuels do.

**Renewable:** As the biofuels are being made with the use of the organic or naturally available plants or even the organic waste so, there is abundant amount of biofuels available and can be made in small time duration. These can be grown with the production of corn which is the used in large amount for the production of the biofuel. Moreover, biofuel can be produced using the waste and in the reverse of it ensure that we extracted all the energy of the biofuel before generation of the waste out of it. Thus biofuels are getting popularity due to the above mentioned reasons.

**Biodegradable:** As discussed before the biofuels are made out of the organic material which are biodegradable in nature [3]. Now as the oil spills from the containers in transportation which are a threat to the life of the aquatic animals if the oil spills on the water of the seas but as the biofuels are biodegradable so they are less toxic to the water animals and also to other human beings or the environment.

**Safer:** For the extraction of the conventional fuels from the earth's surface a number of operations like drilling, mining and refining of the crude oil is done to get the fine quality of fuel but for the production of the biofuel there is no need to perform all these activities instead these are obtained from the plants grown by the farmers in their fields which are not a threat in any of the manners.

**Lubricity:** Biodiesel act as the better lubricant than the petroleum fuels because they have more lubricity than the petroleum diesel. It is beneficial for the engines as it helps in reducing the wear of the engine.

**Sulphur content:** Biodiesel contains no Sulphur content which results in the less pollution as compared to the petroleum fuels [4].

**Oxygen content:** Biodiesel contains more oxygen content than the petroleum fuels which is beneficial because more oxygen content means better combustibility of the fuel but the power developed is slightly less than the petroleum diesel. The oxygen content of the biodiesel and all the other properties can be seen on the Table 1.

| **Biodiesel's physical characteristics** | |
|---|---|
| specific gravity | 0.88 |
| Kinematic Viscosity at 40°C | 4.0 to 6.0 |

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| | |
|---|---|
| Cetane number | 47 to 65 |
| Higher heating value, Btu/gal | ~1,27,960 |
| Lower heating, Btu/gal | ~119.55 |
| Density, lb/gal at 15.5°C | 7.3 |
| Carbon, wt% | 77 |
| Hydrogen, wt% | 12 |
| Oxygen, by dif. wt% | 11 |
| Boiling point°C | 315-350 |
| Flash point °C | 100-170 |
| Sulfur, wt% | 0.0 to 0.0015 |
| Cloud point°C | -3 to 15 |
| Pour point, °C | -5 to 10 |

**Table 1:** Physical properties of the biodiesel and the important properties are mainly the flash point, cloud point and the cetane number for this research paper study.

### Sources of the production of the Biodiesel

Algae are the good source of biodiesel production due to a number of reasons because the biomass productivity of some microalgae is very high as compared to those of the higher plants. Some microalgae grew faster and the lipid and the starch content is also very high which can be up to 30% w/w. Further they are also easy to cultivate. These algae can be cultivated on the no-arable lands or in the water. Thus there is land sharing of the land available for the food production by the algae. Cultivation of the algae in rural environment requires multi-level and multi-cyclic approach for the sharing of the land without any security threat to the food and the water. The cost of production of the biodiesel from the algae is very high. Cellulose is the long polymeric chains of the short chains of glucose which are also the sugar molecules. Cellulose can be commonly found in every day's biological materials like paper, cotton and the wood. Cellulose can be easily digested by the yeast to excrete out the ethanol.

For the large production of the ethanol there must be availability of the cellulose feed stocks so that in the refineries they can be converted to the ethanol with the yeast action on them. Also the cost of the conversion of the cellulose into the ethanol should be reduced to the cost of the production of the gasoline and the ethanol produced from the corn. In India Jatropha was considered to be the main source for the production of the biodiesel but sue to its high cost of investment to the seed ratio it is now a debatable for the production. Secondly edible oils, feed and major crops like palm oil, rapeseed oil, soybean, canola, sunflower, palm kernel, cottonseed, mustard seed, grease, pork, poultry or the beef can also be converted to the biodiesel but due to the scarcity of the food resources in developing countries like India this idea of the production from such above mentioned resources has to be dropped. The production of the biodiesel using the algae is very much feasible and algae can be grown anywhere without much requirement for the space like it can be grown in the deserts, no arable land using the brackish and the saline water.

## Materials and Methods

The process for the production of the biodiesel can be seen in the Figure 1. The process of the generation of the biomass can be seen in the Figure 2. The process for the generation of the ethanol can be seen in the Figure 3. Basic esterification for the synthesis of the biodiesel can be seen in the Figure 4. For the production of the biodiesel and the ethanol food waste and the food resources can be used and the glycerin is also the byproduct during the esterification of the biodiesel. The biodiesel produced must be stored at suitable temperature or by making the blends because the storage technique of the biodiesel varies with the blends of the biodiesel.

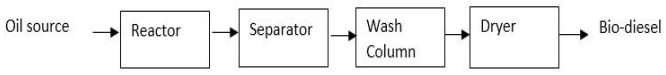


**Figure 1:** Synthesis of the biodiesel from the oil source.

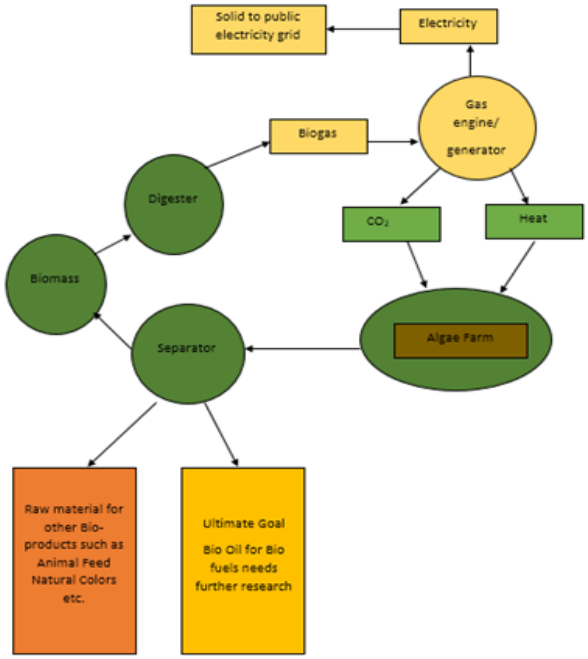


**Figure 2:** Production of the biomass and the raw material for the animal feed. biomass can be further processed for the synthesis of the ethanol and the biofuel.

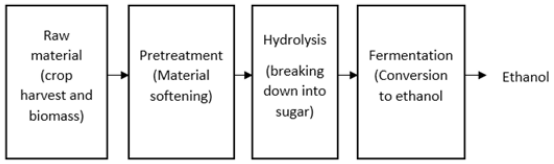


**Figure 3:** Depiction of the production/synthesis of the ethanol from the biomass generated.

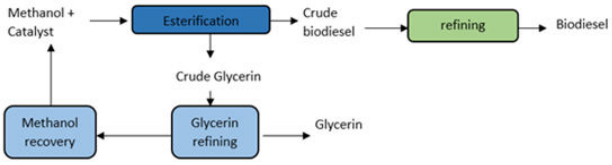


**Figure 4:** Basic esterification process.

| Length of the molecule | Increase the cetane number, heat of emissions |
|---|---|
| Amount of branching | Decrease the gel point |
| saturation | Decrease the NOX emissions improves oxidative stability, reduces deposition |

**Table 2:** Properties of the biodiesel that affect the nature of the biodiesel.

## Results and Discussion

Biodiesel confirms to the ASTM standard D6751 which are consistent and high quality. For biodiesel, the chemical properties as represented in the Table 2 that matters the most are the length of the biodiesel molecule, the amount of branching in the chain and the degree of saturation of the molecule.

As compared to the diesel fuel, biodiesel provides: 93% more energy than the energy required for its production and 41% less emission of Green House Gases (GHG) as compared to the diesel fuel [5]. Use of biodiesel also reduces the HC emissions by 47% [8]. Different blends of the biodiesel as shown in Table 3 meet different standards of the biofuels and the biodiesel cannot meet the full requirements of the demand as compared to the diesel because it meets only the 6% of the diesel demand for the consumption. Secondly the production of the biodiesel or biofuels will be at the cost of the food supplies. For burning of every one unit burning of the fossil fuel and the biodiesel there is production of 4.56 units of energy from the biodiesel [9,10].

| Blend | Percentage of petroleum fuel | Standard met |
|---|---|---|
| B100 | 0 | ASTM D6751 |
| B5 | 5 | ASTM D795 for conventional diesel supply |
| | | ASTM D391 for home heating applications |
| B6-B20 | 6-20 | ASTM D7467 |

**Table 3:** Depiction of the blends of the biodiesel confirming to different biofuel standards.

## Conclusion

Biodiesel is a good source of energy with less toxic emissions and more energy efficiency as compared to the conventional fuels when compared with per unit of each of the fuels. But the handling of the biodiesel is a big problem because it can clog the storage unit due to the formation of the gel due to its low cloud point or it is difficult to use in colder areas as compared to the conventional petroleum products. Blends of the biodiesel can solve the problem. Storage of B100 and B20 is completely different and biodiesel must be stored after reducing its double bond with the hydrolysis process. The production of biodiesel or the biofuels may lead to the consumption of the food resources so, care must be taken for the separate usage of the food resources for the production of the biofuels while meeting the demand for the food supply. Also the use of the blends of the biodiesel from B5 to B20 does not require many changes in the engines of the automobiles or require some minor changes in the existing diesel engines because the biodiesel just burns same as like petroleum diesel. But most of the vehicles approved for the biodiesel blend B20 due its more compatibility and meeting the emission norms. This research paper will be helpful for the researcher and industries to know about the biodiesel properties, the manufacturing process of the biodiesel, the challenges encountered for the storage, usage challenges in engines at various temperatures mainly in cold areas. The main consideration about the biodiesel or the biofuels is in maintaining the supply line of the biodiesel.

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